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Participant no.	Participant organization name	Country
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Proposal

1. Scientific and/or technical quality, relevant to the topics addressed by the call

1.1 Concept and objectives

Railway Vehicles Centre (within text of the proposal abbreviated as "RVC") is research unit within Faculty of Mechanical Engineering Kraljevo (within text of the proposal "the Faculty", short name where needed FME), part of University of Kragujevac (Serbia), which is concerned with research in field of freight wagon design and investigation.

The Centre is leading Serbian institution in the field of railway vehicles investigation and testing, providing research and development services to Serbian wagon factories and Serbian Railways (national railway operator). The Faculty and RVC are established at Kraljevo due to the fact that major Serbian wagon factory there, and has developed as a response to needs of industry, and the Faculty has signed agreement with Wagon Factory Kraljevo for carrying out common research work within RVC. Due to unfortunate political situation in Serbia, wagon industry, and research in respective fields have lost its pace with state-of-the art during past decade. RVC has also developed regional co-operation with other Balkan countries, and is, for its research experience, participant in ongoing FP6 project "RRTC" for establishing regional railway transport research and education institution.

The aim of proposed project is to enhance RVC potentials for railway vehicles research and investigation according to contemporary industry needs. Recent requests for research activities were focused to investigation of railway vehicles dynamics and investigation of fatigue of railway vehicles structures and components, so the project is mainly oriented towards strengthening of the Centre within this research area.

The project goals are to support Railway Vehicles Centre to respond to those needs through realization of the following basic objectives:

- Improvement of knowledge and skills of research staff through exchange of know-how and experience with prominent research centers in EU and development of series of workshops;
- Recruitment of young and experienced researchers whose future work will be primarily oriented towards selected research area;
- Acquisition of new research equipment that will complement present equipment for investigation of quasi-static and dynamic properties of railway vehicles;
- Definition of common research programs with leading EU research centers in respective area, leading to development of strategic partnerships with this institutions.

After achieving project goals, the Centre will be able to participate in research programs of leading European research centers in respective area become integrated part of ERA as well as to provide response to needs of railway vehicles industry in Serbia and Balkan region.

Improvement of knowledge and skills of research staff

RVC has staff with experience varying between 5 and 35 years developed through solving practical problems of railway vehicles design and investigation. Strong link with industry, however, has sometimes being obstacle for stronger development of some contemporary railway research areas that hadn't immediate impact in industry practice. Combined with years of political isolation that

lead to absence from international conferences, non-existence of cooperation with European institutions and lack of contemporary literature and, eventually, to falling behind state-of-the art in some vital research area. Therefore, RVC needs not only re-education of its staff but also a strong research partner for two reasons:

- to support establishment of research programs and research groups for relevant topics;
- to provide leadership after project is ended in order to ensure sustainability of project results; no matter how good results of project might be, if RVC does not participate in common research projects within ERA, it will lose step with development again.

Taking into consideration all previously mentioned facts, and especially the fact that project is to re-educate researchers with experience, two-way secondments with prominent European research centers seems to be the best mechanism for accomplishing of the objective. For appropriate development of selected research fields (railway vehicles dynamics and railway vehicles structures and components fatigue) there should be realized **three kinds of two-way secondments**:

- in field of experimental research of railway dynamics;
- in field of theoretical research of railway dynamics;
- in field of theoretical research of mechanical structures and components fatigue.

Two-way secondments will enable RVC research staff to take part in advanced projects of our partners, learning both about methodologies and problems, and, in return, their experts will provide us help to apply advanced concepts to our problems. Secondments will be carried out under agreements that would guarantee return of seconded personnel, protecting from "brain-drain". RVC has already got *consents from KTH University Railway Group (Sweden) and company "Mer Mec" (Italy)* that they will support two-way secondments contributing to this project objective.

Next mechanism that would contribute to the project objective is study visits, practice that have shown success in improving knowledge in past. Study visits are shorter, but allow group-to-group interaction with wider impact, so they are suitable for studying state-of-the art and establishment of personal contacts. The project is to make use of **four study visits** to prominent research facilities that are carrying experimental research of railway vehicle dynamics and mechanical structures and components fatigue.

Last mechanism that is to be employed to improve knowledge is organization of workshops concerned with selected research fields. The leaders of those activities will be researchers that took part in two-way secondments. The main task of workshops is to educate RVC researchers from all fields with progresses in respective area in order to enhance cooperation between RVC groups. The workshops will contribute also to dissemination and sustainability of project results by providing research results to young researchers, engineers and colleagues from research institutions from Serbia and Balkan region. The project is to support **four workshops** in course of project duration:

- workshop on experimental methods of railway vehicles dynamics;
- workshop on theoretical methods of railway vehicles dynamics;
- workshop on experimental methods of mechanical structures and components fatigue;
- workshop on theoretical methods of mechanical structures and components fatigue.

Recruitment of staff

RVC has at the moment two mechanical engineers with PhD, one electrical engineer with PhD, and one mechanical engineer with MSc degree, supported by two mechanical engineers and two

technicians. In order to develop research programs in selected fields, it needs to employ both experienced and young researchers. To achieve this goal, it will look both for internal resources of the Faculty for improvement of research program of mechanical structures and components fatigue, and to external help by engaging experienced researchers in field of railway vehicles dynamics. The primary targets are Serbian researchers that moved to EU countries and USA, but we believe that experienced researchers from West Balkan and East Europe countries may be also interested to join to work of the RVC.

The project is to contribute to this goal by providing **two experienced researchers** (preferably one for experimental and one for theoretical dynamics of railway vehicles) a chance to develop their own program in Serbia within project framework under favorable conditions, acting like "research incubator". After project is ended, those researchers are to be capable to continue advanced research work due to partnerships established.

Young researchers would be attracted by possibility to work with recognized experts at inspiring problems, and to learn about advanced topics. The project is to lead to engagement of **at least two PhD students** to work at RVC.

Project will also enable RVC to mobilize **researchers within Faculty** that are currently dealing with mechanical structures and components fatigue to move their focus to specific aspects of investigation of fatigue problems of railway vehicles structures and components. Researchers from the *Faculty's Department for Mechanical Structures* agreed to support project work by assigning **two PhD students** for the work on the project.

Acquisition of new research equipment

In course of its previous work RVC has developed and acquired equipment needed for railway vehicles investigations. It *already has built or purchased* the following:

- Equipment for investigation of static properties of railway vehicles
 - Test stand for application of static forces;
 - Electronic measurement equipment for measurement of static stresses;
- Equipment for measurement of quasi-static properties of railway vehicles
 - Test stand for measurement of torsion stiffness of railway wagons
- Equipment for investigation of dynamic properties of railway vehicles
 - Test stand for investigation of impacts of railway vehicles;
 - Electronic measurement equipment for measurement of dynamic properties;
- Equipment for investigation of braking of railway vehicles in static conditions and during the ride.

The project is to support development and acquisition of advanced test tracks and measurement equipment that will enable RVC to perform state-of-the art experimental investigations of quasi-static and dynamic properties of railway vehicles.

Test track for investigation of quasi-static properties of railway vehicles

Contemporary research results have shown that credible estimations of derailment safety of railway vehicle cannot be made without quasi-static tests comprising pushing of railway vehicles through test track with unfavorable track geometry ("S-curve", defined in International Railway Union standard UIC 530-2).

The project is to contribute to **construction of test track** with defined geometry. Such task comprises investigation of experiences of research centers that already constructed similar test tracks, development of documentation, tendering procedure and construction works. While development and selection of track parameters is subject of railway engineering, large part of this task is subject of civil building engineering, so subcontracting will be employed here.

Development of test track is, in general, complex task, being that it usually requires access tracks to be built also. However, *Wagon Factory Kraljevo already gave consent to support the project* by preparation of part of its inner track so that construction of test track is reduced only to S-curve and stopping track.

Equipment for measurement of forces at wheel-rail contact

Important part of contemporary research work in field of railway dynamics is devoted to measurement and calculation of forces acting at wheel-rail contact (like "SAMBA 3" project of KTH University, ongoing research projects of University of Newcastle and Manchester Metropolitan University in Europe, Railway Technical Research Institute in Japan or "Smart Trains" project of Central Queensland University in Australia). One of important results of those investigations is that critical parameter determining railway vehicle ride safety and track fatigue, ratio of horizontal and vertical component of wheel-rail contact force is to be measured *as close to contact point as it is possible* and by methodology that is *as direct as it is possible*. This conclusion became part of international standards (International Railway Union UIC-518, for example). RVC has developed its own indirect methodology of measurement forces in wheel-rail contact based on measurement of accelerations and forces acting on axis bearings. Acquisition of contemporary equipment capable of measuring the forces at contact point would be a great improvement of capabilities of RVC.

The project is to contribute to re-enforcement of RVC by supporting **provision of equipment for measurement of forces in wheel-rail contact**. This task requests tendering procedure, analysis of offered measurement methodologies, purchasing of equipment and training of RVC staff for application of selected equipment.

Definition of common research programs with leading EU research centers

Accomplishment of the goal will be enhanced by accomplishment of other project goals, being that researchers who took part in exchange of know-how are to be carriers of the activity, which is to be carried out in accordance with both knowledge, staff and equipment provided through course of the project.

Essentially a final goal of the project, definition of common research programs is not only to provide sustainability to project results, but also to provide their maximum impact in practice by integrating research efforts in order to reduce multiple investigations of basic research topics without influence on competitiveness of research centers or manufacturers (it especially holds for railway safety topics).

At least two common research programs are to be developed, one considering railway vehicles dynamic research, and the other considering mechanical structures and components fatigue.

As summary, overall project concept may be represented visually by scheme on Figure 1. Two research fields that are to be improved during project course represents two vertical "pillars" of re-enforcement of RVC which are to be established by achievement of four project objectives. Arrows are representing mutual influence of project objectives, suggesting in the same time the order of project activities and work packages.

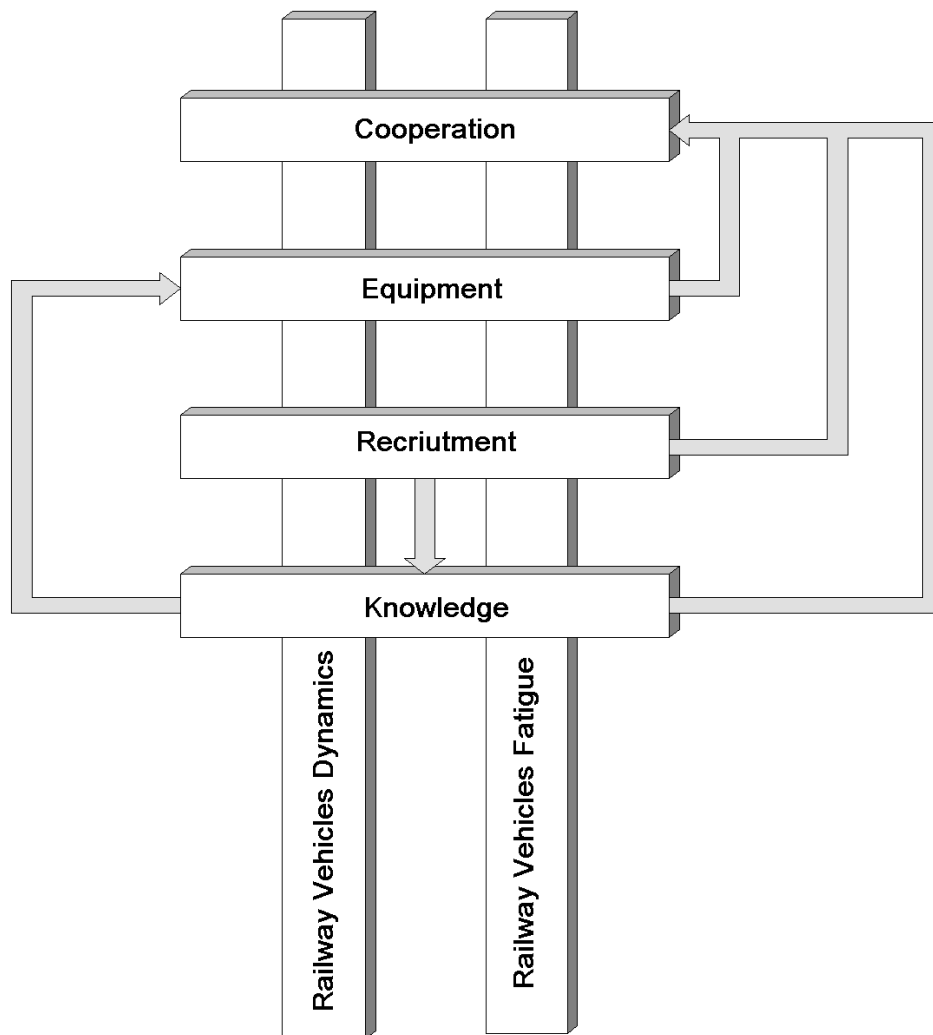


Figure 1. Schematic representation of project objectives

1.2 Contribution to the co-ordination of high quality research

The aim of the project itself is to improve RVC to the level that it is able to take part in **high quality research** projects, which is not case at the moment, partly due to lack of knowledge, staff and equipment, and partly due to lack of persistent need for high class research at markets of Serbia and Balkan. Accomplishment of presented project objectives will remove those obstacles between RVC and high quality research.

The concept of the project, improvement and re-enforcement of RVC **through establishing partnerships** with prominent research institutions guarantees that **research activities would be coordinated** with its partners through achievement of its final objective, **development of common research programs**, which high quality is guaranteed by presence and prominence of leading EU partners that will become partners.

RVC has acknowledged importance of cooperation and co-ordination of research activities in the past where the first step in that direction was participation in establishment of Regional Centre for Research and Education in Transport (**RRTC**), non-profit and non-government institution registered in Sofia (Bulgaria) with aim to co-ordinate research activities across Balkan region,

acting like coordinating centre of network of Balkan transport research and education institutions. RRTC is established in course of FP6 SSA project with the same acronym.

RVC responsibility in that project was development of work program of RRTC in area of research. During RRTC project, representatives met with representative of **EURNEX**, and discussed possibilities of co-operation of two research networks. It is concluded that development problems of railways in region of Balkan and well-developed part of Europe are at different levels, and that creative approach is needed to apply research results in practice.

Being that RVC is one of main resources of research for railway vehicles industry in Serbia, as well in Balkan region (list of co-operating industry partners is given in part 3.2 of the document), establishment of co-operation with prominent research institutions in European Union would significantly contribute both to development and dissemination of high quality research results in whole region. Its established co-operation with other Serbian and Balkan research institutions (listed also later in part 3.2 of the document) will contribute to **inclusion of their researchers in advanced projects**, too.

1.3 Quality and effectiveness of the support mechanisms, and associated work plan

Overall strategy

The strategy to achieve project objectives is developed under influence of several important factors that lead to selection of support mechanisms that are believed to be most appropriate for the project.

- Human resource re-enforcement
 - Present RVC staff consists of experienced researchers with four of them being in the same time university teachers at the age ranging from 30 to 65; for teaching and family reasons their mobility is decreased; therefore, human resource improvement demands shorter types of leave of absence for them; that lead us to conclusion that two-way secondments, study visits and workshops as support mechanisms suitable for improvement of knowledge of present staff;
 - Present staff is not enough for carrying out advanced research; being that only young researchers engagement would not benefit to development of advanced research activities, engagement of experienced researchers, unable under present research market requests, is mechanism that would support re-enforcement of the centre during project course; after the project is ended those researchers will continue with their work in conditions of already developed research programs on domestic and international projects.
- Improvement of research equipment
 - Although it's easy to say that without advanced equipment there is no advanced research, the real question is selection of research equipment. Test track for quasi-static investigation of railway vehicles and measurement equipment for wheel-track interaction were selected for two reasons: 1) such equipment does not exist in Serbia (neither in the rest of Balkan region), and 2) they are needed for development of high quality research in field of railway vehicles dynamics. At last, being that contemporary railway dynamics rely on computer simulation of railway vehicles dynamics based on tested models, provision of commercial software packages would largely contribute to effectiveness and competitiveness of research that are carried out.

- Sustainability of project results
 - The strongest threat to project outcomes may be lack of top research requests from surroundings which are real driving force of development of research; mechanism selected to ensure sustainability of project results is development of strategic partnerships with prominent research institutions being that participation in advanced research projects would ensure that RVC will keep pace with state-of-the-art in respective research area.

Arrangement of applied mechanisms into work packages and their timing is developed according to the following (sometimes contradicting) requests:

- intention to maximize effect of foreseen activities on project objectives, which forced human resources development ahead of provision of equipment;
- the fact that effect of secondments and study visits is maximal when they are performed while hosting side has working activities of interest for visiting side; therefore, while durations of secondments and study visits are predictable, their start dates and end dates should be movable;
- on one side, tendency to group activities according to their contribution to requested objectives, and on the other side, tendency to group activities according to research field to which they contribute for the sake of easier human resources management.
- general independence of activities concerned with improvement of railway vehicles dynamics research program from activities concerned with improvement of railway vehicles fatigue research program, leading to parallelism (and twinning) between those activities.
- dependencies between (by its nature independent) activities and work packages caused by the fact that personnel that gained knowledge in one phase of the project is to use it for preparatory activities (not essential activities) in other project phases;
- assumption that recruitment and provision of equipment are the activities that carry the most of uncertainties regarding their duration;
- tendency to move activities depending on equipment providers towards start of the project in order to provide time reserves for case of delay in process of equipment delivery;

Considering previous factors, activities are grouped into seven work packages:

- **WP-1: Exchange of know-how**, grouping activities that lead to improvement of knowledge of present staff of RVC and the Faculty, therefore two-way secondments and study visits. As some of other work packages, it has twinned structure, supporting similar activities performed for both selected research fields (project "pillars").
- **WP-2: Recruitment**, grouping activities that are to contribute to employment of new staff within RVC, oriented towards investigations in selected research area;
- **WP-3: Workshops**, grouping activities centered on workshops considering contemporary achievements in selected research area; this work package also has twinned structure of activities concerning railway vehicles dynamics and railway vehicles fatigue activities. Workshops are being separated to separate work package being that they contribute both to re-enforcement of knowledge and project results dissemination. This package, however, depends on WP-1 being that the staff seconded in WP-1 will prepare workshops in cooperation with institutions to whom they established partnerships during WP-1.

- **WP-4: Equipment**, grouping activities leading to provision of equipment. This packet has three groups of activities, first considering provision of equipment for measurement of wheel-rail interactions, the second considering construction of test track, and the third considering provision of software package for simulation of railway vehicles dynamics. This work package should also wait for relevant activities from WP-1 to be finished being that appropriate selection of equipment and methodologies depends on knowledge and experiences gathered during WP-1.
- **WP-5: Defining strategic partnerships**, group of activities that are to result in development of common research programs between RVC and prominent research institutions in respective research field.
- **WP-6: Promotion and dissemination**, group of activities concerning raising both public and professional awareness, promotion of project results, and application of the results in practice of RVC academic and industry partners network.
- **WP-7: Management**, group of activities concerning with project progress monitoring, taking preventive measures, application of contingency activities, accounting, internal and external reporting.

Overall duration of project is three years. Timelines of work packages are presented at Figure 2 at page 26, while work package timelines and dependencies are presented later.

Table 1.3 a: Work package list

Work package No ¹	Work package title	Type of activity ²	Lead partic no. ³	Lead partic. short name	Person-months ⁴	Start months ⁵	End month ^{Er} ror! Bookmark not defined.
WP-1	Exchange of know-how	SUPP	1	FME	8	2	18
WP-2	Recruitment	SUPP	1	FME	72	1	36
WP-3	Workshops	SUPP	1	FME	4	15	35
WP-4	Equipment	SUPP	1	FME	8	10	25
WP-5	Defining strategic partnerships	SUPP	1	FME	2	25	28
WP-6	Promotion and dissemination	SUPP	1	FME	5	1	36
WP-7	Management	MGT	1	FME	8	1	36
	TOTAL				107		

¹ Work package number: WP 1 – WP n.

² Please indicate one activity per work package:

SUPP = Support activities; TRA = Training; MGT = Management of the consortium.

³ Number of the participant leading the work in this work package.

⁴ The total number of person-months allocated to each work package.

⁵ Measured in months from the project start date (month 1).

Table 1.3 b: Deliverables List

Del. no. ¹	Deliverable name	WP no.	Nature²	Dissemination level³	Delivery date⁴ (proj. month)
1.1	Activity report: Secondments for experimental methods of railway vehicles dynamics	1	R	PU	10
1.2	Activity report: Secondments for theoretical methods of railway vehicles dynamics	1	R	PU	10
1.3	Activity report: Secondments for theoretical methods of mechanical structures fatigue	1	R	PU	15
1.4	Activity report: Study visits for experimental methods of railway vehicles dynamics	1	R	PU	15
1.5	Activity report: Study visit for experimental methods of mechanical structures fatigue	1	R	PU	18
2.1	Employment of two young researchers	2	O	PU	12
2.2	Employment of two experienced researchers	2	O	PU	18
3.1	Workshop on experimental methods in railway vehicles dynamics	3	O	PU	19
3.2	Workshop on theoretical methods in railway vehicles dynamics	3	O	PU	22
3.3	Workshop on theoretical methods in mechanical structures and components fatigue	3	O	PU	31
3.4	Workshop on experimental methods in mechanical structures and components fatigue	3	O	PU	35

¹ Deliverable numbers in order of delivery dates. Please use the numbering convention <WP number>.<number of deliverable within that WP>. For example, deliverable 4.2 would be the second deliverable from work package 4.

² Please indicate the nature of the deliverable using one of the following codes:

R = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

³ Please indicate the dissemination level using one of the following codes:

PU = Public

PP = Restricted to other programme participants (including the Commission Services).

RE = Restricted to a group specified by the consortium (including the Commission Services).

CO = Confidential, only for members of the consortium (including the Commission Services).

⁴ Measured in months from the project start date (month 1).

4.1	Equipment for measurement of wheel-rail contact forces delivered and personnel trained	4	O	PU	13
4.2	Software package for simulation of railway dynamics operational	4	O	PU	11
4.3	Test track operational	4	O	PU	25
5.1	Common research program in field of railway vehicles dynamics	5	O	PU	26
5.2	Common research program in field of mechanical structures and components fatigue	5	O	PU	27
6.1	Project website active	6	O	PU	1
6.2	Media conferences	6	O	PU	4
					17
					28
					36
6.3	Info days	6	O	PU	12
					24
					36
7.1	Project reports for year	7	O	PU	13
					25
7.2	Final report	7	O	PU	36

Table 1.3 c: Work package description

Work package number	WP-1	Start date or starting event:					2. month
Work package title	Exchange of know-how						
Activity type ¹	SUPP						
Participant number	1						
Participant short name	FME						
Person-months per participant	8						

Objectives

Improvement of knowledge and skills of selected RVC staff.

Description of work

The work package supports exchange of know-how and learning through two-way secondments and study visits. Work on WP comprises two sub-packages, one considering improvement of railway vehicles dynamics research, and the other improvement of railway vehicles structures and components fatigue research. These sub-packages are simultaneous, being that engaged staff is different.

The tasks within the WP are:

1. Railway vehicles dynamics	2. Railway vehicles fatigue
<p>1.1. Experimental methods of dynamics of railway vehicles</p> <p>1.1.1. Two-way secondments for development of measurement techniques in railway vehicles dynamics in total extent of 12 research-months and total duration of activities of 6 months</p> <p>1.1.2. Three study visits to three leading research centers carrying out experimental investigation of railway vehicles</p> <p>1.2. Theoretical methods of dynamics of railway vehicles</p> <p>1.2.1 Two-way secondments for computational methods of railway vehicles dynamics in total extent of research-12 months and total duration of activities of 6 months</p>	<p>2.1. Theoretical methods of mechanical structures and components fatigue</p> <p>2.1.1. Two-way secondment for theoretical methods of mechanical structures and components fatigue in total extent of 6 research-months and total duration of activities of 3 months</p> <p>2.2. Experimental methods for investigation of mechanical structures and components fatigue</p> <p>2.2.1 One study visit to leading research centre carrying out experimental investigation of railway vehicles</p>

The activity does not contain serious risks within it. Its major risk would be inability to establish relevant research programs regarding secondments or study visits; however, with expressed consents from KTH University Railway Group (regarding support of secondments for theoretical methods of railway vehicle dynamics) and Mer Mec (regarding support of secondments for measurements of railway vehicle dynamics parameters) and experience from past (regarding study visits to DB Zentralamt research center at Minden, SNCF research center in Vitry-sur-Seine and University of Derby), this risk is estimated as small.

¹ Please indicate one activity per work package:

SUPP = Support activities; TRA = Training; MGT = Management of the consortium.

However, proper timing of activities may be uncertain because of the need to synchronize visiting times with relevant activities of the host institution. Therefore, the starting time and order of some activities (especially study visits) may be changed, which may influence to timing other work packages because WP-1 is on critical path of the project. In order to cope with such scenario, dependent activities are arranged so as to provide 6 months of time reserves. If necessary, more researchers will be devoted to WP-5 "Definition of strategic partnerships" which would be most likely affected by potential delay of WP-1 activities.

Timelines of WP-1 are shown at Figure 3 at page 26.

Deliverables

- 1.1 Activity report: Secondments for experimental methods of railway vehicles dynamics (10. month)
- 1.2. Activity report: Secondments for theoretical methods of railway vehicles dynamics (10. month)
- 1.3. Activity report: Secondments for theoretical methods of mechanical structures fatigue (15. month)
- 1.4. Activity report: Study visits for experimental methods of railway vehicles dynamics (15. month)
- 1.5. Activity report: Study visit for experimental methods of mechanical structures fatigue (18. month)

Work package number	WP-2	Start date or starting event:	1. month
Work package title	Recruitment		
Activity type¹	SUPP		
Participant number	1		
Participant short name	FME		
Person-months per participant	72		

Objectives

To re-enforce human resources of RVC by employment of experienced and young researchers

Description of work

The activity has two tasks: employment of young researchers and employment of experienced researchers.

Young researchers will be recruited for among PhD students from the Faculty and/or other Serbian universities.

Experienced researchers would be first looked for in contacts with Serbian colleagues working in EU countries and USA, and then among colleagues from Balkan countries with help from RRTC. Search will also employ Internet resources for employment of engineers.

This may be the activity with most risk in the whole project, being that it is really hard to predict when will experienced and motivated researchers will be found and engaged. In order to cope with this problem, other project activities were planned not to depend on experienced researchers, and (for Serbian conditions) significant amount of financial resources (comparable to those in "People" project) are planned for work of engaged experienced researchers during project duration, to enable experienced researchers to develop their own research activities in cooperation with EU partners, so they can carry on with researches within RVC after project end.

Timelines of WP-2 are shown at Figure 4 at page 26.

Deliverables

2.1. Employment of two young researchers (12. month)

2.2. Employment of two experienced researchers (18. month)

¹ Please indicate one activity per work package:

SUPP = Support activities; TRA = Training; MGT = Management of the consortium.

Work package number	WP-3	Start date or starting event:	15. month
Work package title	Workshops		
Activity type¹	SUPP		
Participant number	1		
Participant short name	FME		
Person-months per participant	4		

Objectives

To improve knowledge of complete RVC research staff considering selected research fields and to contribute to dissemination of project results.

Description of work

Researchers that took part in secondments within WP-1 will organize workshops with respective research field as topic. Workshops will consist of series of lectures by invited experts (selected by seconded researchers and EU partners), practical exercises and discussions on problems that attendees have in practice. Attendees will be RVC researchers, researchers from other Serbian and Balkan institutions, and engineers from railway vehicles factories.

Four workshops are to be organized, two considering topics from railway vehicles dynamics (one for experimental and the other for computational research methods), and two considering topics from mechanical structures and components fatigue (one for experimental and the other for computational research methods).

The work package does not contain inherent risks. However, during project course, in coordination with other activities and availability of invited researchers, start and end dates may be moved.

Timelines of WP-3 are shown at Figure 5 at page 27.

Deliverables

- 3.1. Workshop on experimental methods in railway vehicles dynamics (19. month)
- 3.2. Workshop on theoretical methods in railway vehicles dynamics (22. month)
- 3.3. Workshop on theoretical methods in mechanical structures and components fatigue (31. month)
- 3.4. Workshop on experimental methods in mechanical structures and components fatigue (35. month)

¹ Please indicate one activity per work package:

SUPP = Support activities; TRA = Training; MGT = Management of the consortium.

Work package number	WP-4	Start date or starting event:	10. month
Work package title	Equipment		
Activity type¹	SUPP		
Participant number	1		
Participant short name	FME		
Person-months per participant	8		

Objectives

Provision and construction of equipment needed for carrying out contemporary railway vehicles dynamics research.

Description of work

Work package has three sub-packages: 1) Provision of equipment for measurement of forces in wheel-rail contact; 2) Provision of test track for investigation of quasi-static properties of railway vehicles (S-curve) 3) Provision of software for railway vehicles dynamics simulation. Being that this WP comprises lot of purchasing and sub-contracting, all sub-packages have similar structure of tasks, using tendering procedures determined by relevant laws. Work package is broken into tasks as follows:

1.Measurement of wheel-rail forces	2. S-curve	3. Software
1.1. Tendering 1.2. Selection of equipment 1.3. Delivery of equipment 1.4. Training of RVC personnel	2.1. Selection of construction site 2.2. Design of test-track 2.2.1. Preparations 2.2.2. Analysis of experiences of similar test tracks through visits to operational test tracks in Europe 2.2.3. Development of test track concept 2.2.4. Development of draft drawing 2.2.5. Development of final drawing 2.3. Selection of contractor 2.3.1 Tendering procedure 2.3.2 Decision on contractor 2.4. Construction of test track 2.5. External verification	3.1. Tendering 3.2. Selection of equipment 3.3. Delivery of equipment 3.4. Training of RVC personnel

The most important risk within this work package is possibility of time delays because of delays in procedure of equipment delivery (transport delays, customs delays and similar) and various delays of construction works. In order to protect project from influences of those delays, the WP is moved towards start of the

¹ Please indicate one activity per work package:

SUPP = Support activities; TRA = Training; MGT = Management of the consortium.

project as it is possible, so significant amount of time reserve is provided to WP relevant to the project end (12 months). Being that other project activities do not rely on equipment that is provided, successful accomplishment of project goals is thus protected to maximal possible extent.

Timelines of WP-4 are shown at Figure 6 at page 27.

Deliverables

- 4.1. Equipment for measurement of wheel-rail contact forces delivered and personnel trained (13. month)
- 4.2. Software package for simulation of railway dynamics operational (11. month)
- 4.3. Test track operational (25. month)

Work package number	WP-5	Start date or starting event:					25. month
Work package title	Defining strategic partnerships						
Activity type ¹	SUPP						
Participant number	1						
Participant short name	FME						
Person-months per participant	2						

Objectives

To establish strategic partnerships that will support sustainable development of railway vehicles research within RVC.

Description of work

The work package consists of two tasks, one considering railway vehicles dynamics, the other for mechanical structures and components fatigue. Tasks are by its nature, independent, are to be carried out by different teams and form work package only because of the same objective.

Tasks comprise of development of program proposal version by team formed by representatives of RVC and EU partner. The proposal is to be discussed by institutions and final version is to be adopted.

Timelines of WP-5 are shown at Figure 7 at page 28.

Deliverables (brief description and month of delivery)

5.1. Common research program in field of railway vehicles dynamics (26. month)

5.2. Common research program in field of mechanical structures and components fatigue (27. month)

¹ Please indicate one activity per work package:

SUPP = Support activities; TRA = Training; MGT = Management of the consortium.

Work package number	WP-6	Start date or starting event:	1. month
Work package title	Promotion and dissemination		
Activity type¹	SUPP		
Participant number	1		
Participant short name	FME		
Person-months per participant	5		

Objectives

To distribute information about project results, and spread application of project results to maximal extent.

Description of work

Promotional activities are to be carried through whole project duration. The following activities will be carried out:

- 4 media conferences to inform general public in Serbia will be held (one at the project start, and one at the end of each project year);
- 3 Info days for professional public in Balkan region will be held (one after each project year);
- project website will be developed to widely present project results;
- promotional materials will be developed (brochures and memorabilia)
- project results will be presented at international scientific conferences

Timelines of WP-6 are shown at Figure 8 at page 28.

Deliverables (brief description and month of delivery)

6.1. Project website active (1. month)

6.2. Media conferences (4. month, 17. month, 28. month, 36. month)

6.3. Info days (12. month, 24. month, 36. month)

¹ Please indicate one activity per work package:

SUPP = Support activities; TRA = Training; MGT = Management of the consortium.

Work package number	WP-7	Start date or starting event:	1. month
Work package title	Management		
Activity type¹	MGT		
Participant number	1		
Participant short name	FME		
Person-months per participant	8		

Objectives

To ensure project progress in proper and timely manner.

Description of work

Project management may be divided into permanent, periodic and reporting activities.

Permanent activities are task-oriented, and mainly include quality management monitoring, like weekly activity team meetings.

Periodic activities are timely regular, and mainly project-oriented. They include team leader meetings and consortia meetings. Team leader meetings are to be held each month, and consortia meetings once each year, being themselves preparation for yearly reports.

Reporting activities are to be organized according internal rules of the Faculty, and according procedures prescribed in grant agreement.

Timelines of WP-7 are shown at Figure 9 at page 28.

Deliverables (brief description and month of delivery)

7.1. Project reports for year (13. month, 25.month)

7.2. Final report (end of project)

¹ Please indicate one activity per work package:

SUPP = Support activities; TRA = Training; MGT = Management of the consortium.

Table 1.3 d: Summary of staff effort

Participant no.	Participant short name	WP							Total person months
		1	2	3	4	5	6	7	
1	FME	8	72	4	8	2	5	8	107
2									
Total		8	72	4	8	2	5	8	107

Table 1.3 e: List of milestones

Milestone number	Milestone name	Work package(s) involved	Expected date ¹	Means of verification ²
1	Website active	WP-6	1	website content available over Internet
2	media conference	WP-6	4	reports present in media
3	secondment for exp. dynamics	WP-1	10	activity report available
4	secondment for th. dynamics	WP-1	10	activity report available
5	measurement equipment selected	WP-4	11	documented
6	software selected	WP-4	11	documented
7	young researchers employed	WP-2	12	employment contracts
8	Info day held	WP-6	12	activity report available
9	measurement equipment delivered	WP-4	14	equipment present at RVC

1 Measured in months from the project start date (month 1).

2 Show how you will confirm that the milestone has been attained. Refer to indicators if appropriate. For example: a laboratory prototype completed and running flawlessly; software released and validated by a user group; field survey complete and data quality validated.

10	measurement equipment operational	WP-4	14	test measurements performed
11	secondment for fatigue	WP-1	15	activity report available
12	study visits for dynamics	WP-1	15	activity report available
13	media conference	WP-6	16	reports present in media
14	location for test track selected	WP-4	17	documented
15	experienced researchers employed	WP-2	18	employment contracts
16	study visit for fatigue	WP-2	18	activity report available
17	workshops for th. dynamics	WP-3	19	workshop publication
18	final drawing of test track finished	WP-4	22	final drawing of test track available
19	workshops for exp. dynamics	WP-3	22	workshop publication
20	contractor for test track selected	WP-4	23	documented
21	Info day held	WP-6	24	activity report available
22	test track operational	WP-4	25	report of external auditor
23	common research program on dynamics	WP-5	26	program adopted by partners
24	common research program on fatigue	WP-5	27	program adopted by partners
25	media conference	WP-6	28	reports present in media
26	workshops for th. fatigue	WP-3	31	workshop publication

27	workshops for exp. fatigue	WP-3	35	workshop publication
28	media conference	WP-6	36	reports present in media
29	Info day held	WP-6	36	activity report available

Timelines

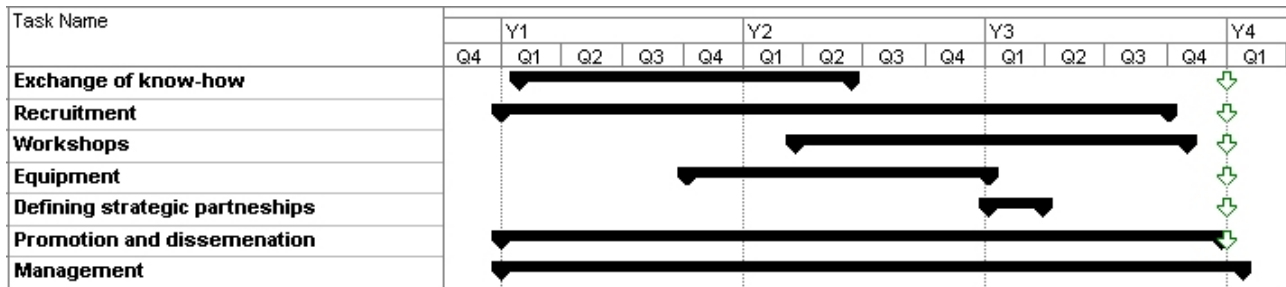


Figure 2. Timelines of work packages

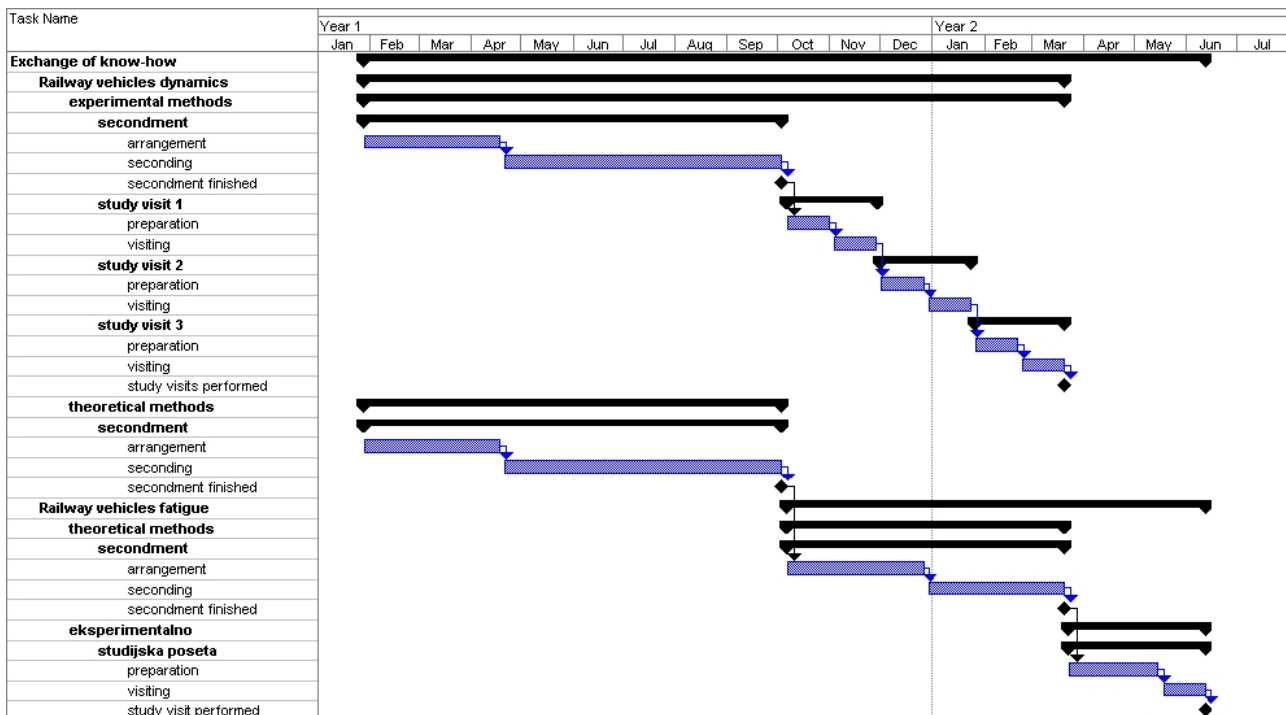


Figure 3. Timelines of WP-1

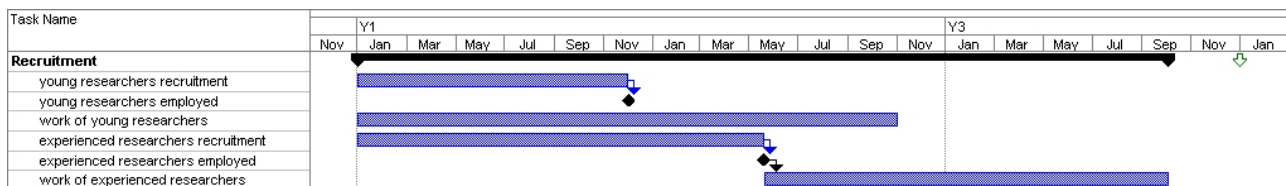


Figure 4. Timelines of WP-2

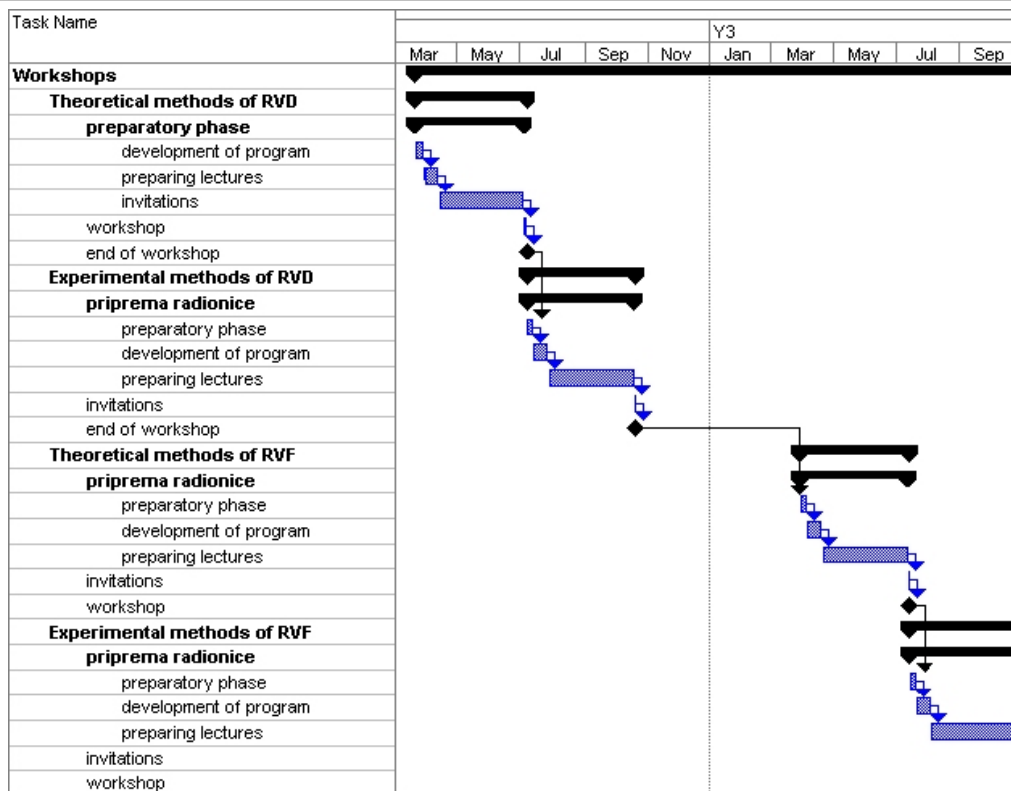


Figure 5. Timelines of WP-3

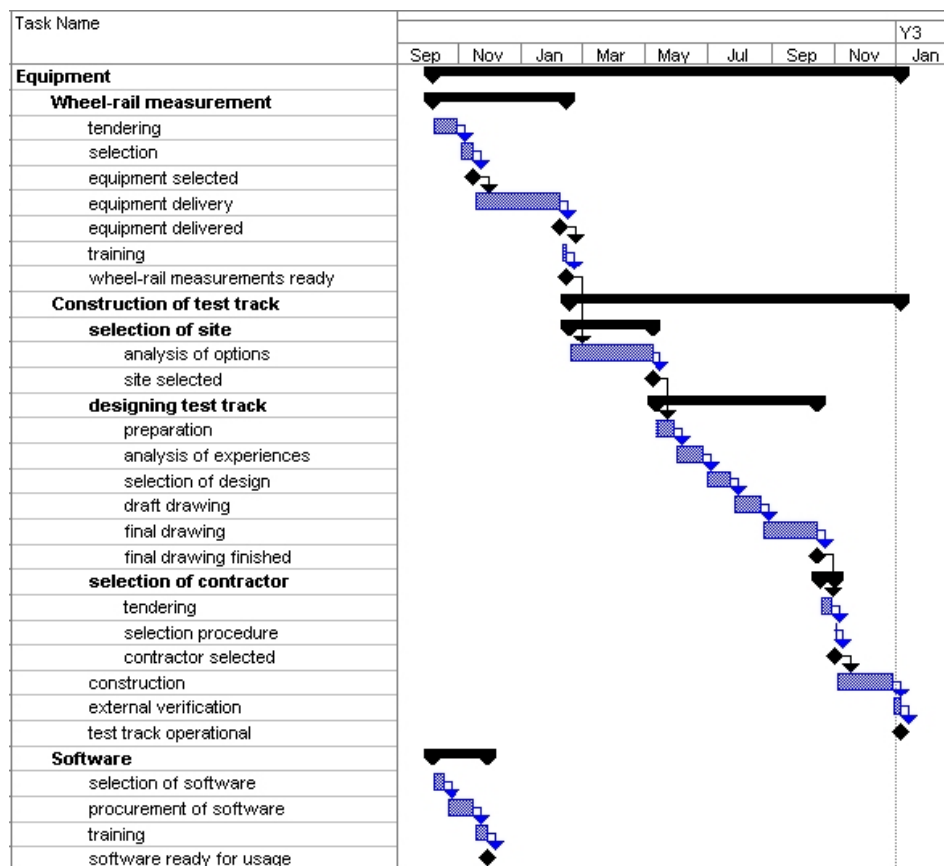


Figure 6. Timelines of WP-4

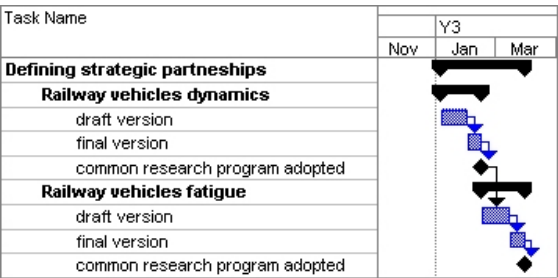


Figure 7. Timelines of WP-5

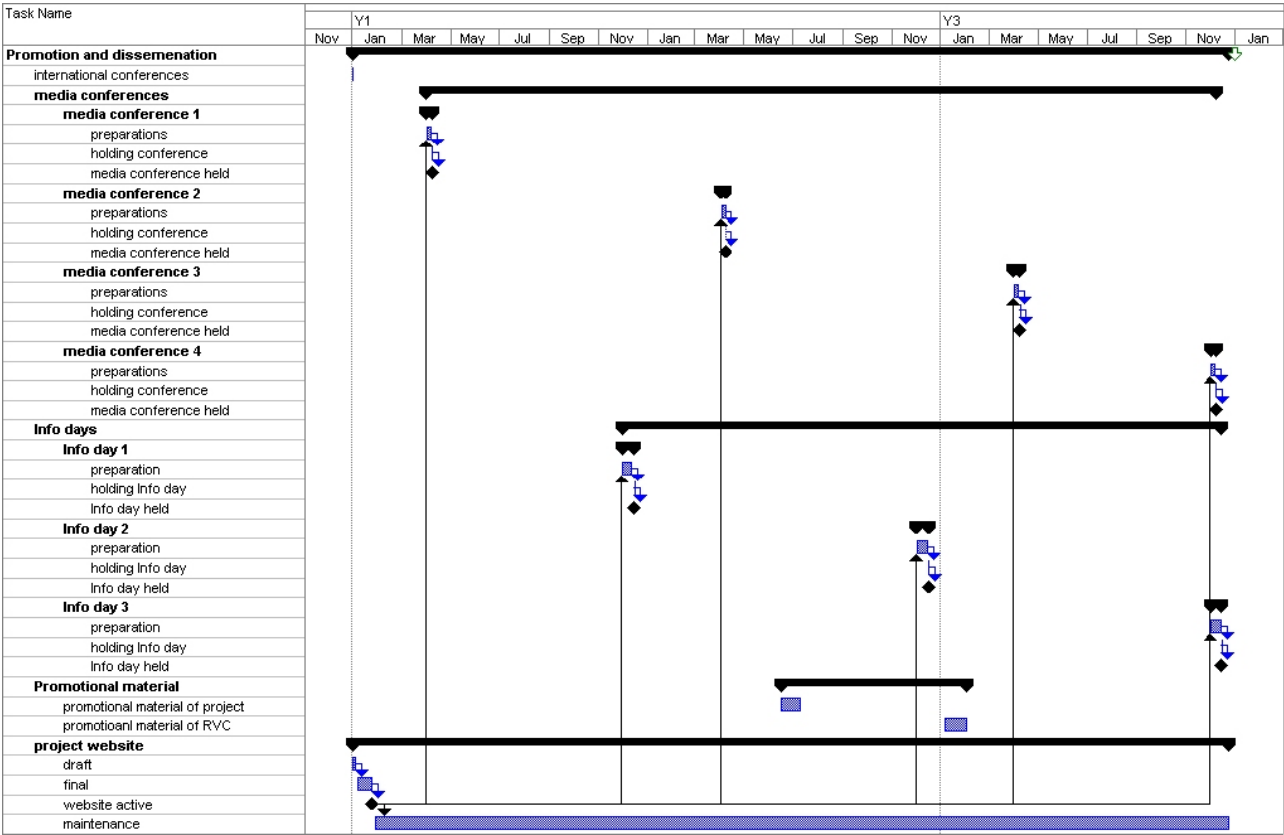


Figure 8. Timelines of WP-6

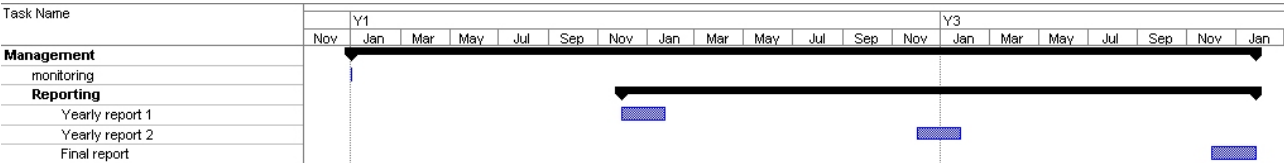


Figure 9. Timelines of WP-7

2. Implementation

2.1 Management structure and procedures

Project management is **simple** being that **the Faculty is the only member** of project consortium. Management structure and procedures of the project are derived from management structure and procedures applied on the other Faculty projects.

Management structure is **hierarchical**, and presented at Figure 10. At the **top** of management structure is project **Coordinator, Head of Railway Vehicles Center**. He is **autonomous** in his work regarding allocation of project resources and organization of project activities. However, he is **responsible to the Dean of the Faculty** regarding successfulness of project results.

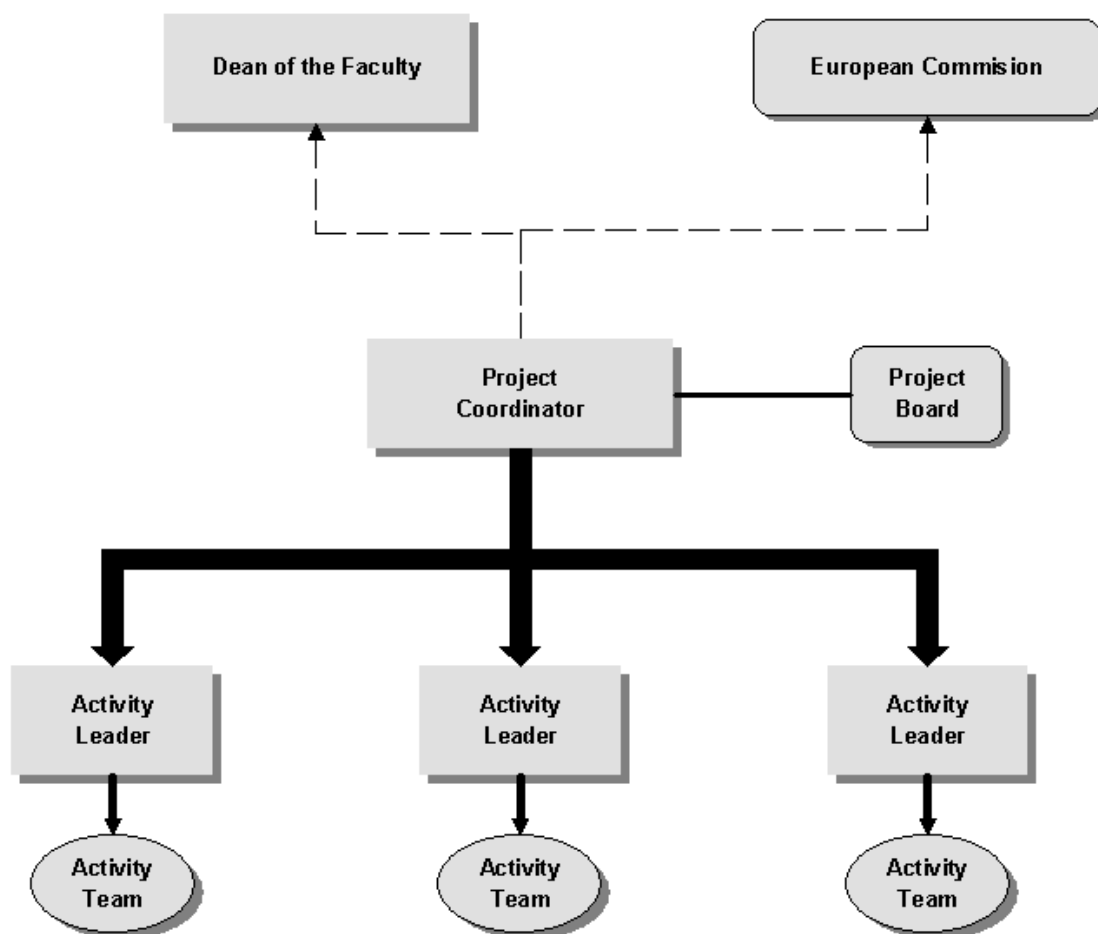


Figure 10. Project management structure

Project Board is advisory body that is providing Coordinator with analysis and suggestions regarding project progress. Project Board consists of Coordinator and four members, each of them with specific area of expertise:

- activities concerned with development of railway vehicles dynamics research;
- activities concerned with development of mechanical structures and components fatigue research;
- activities concerned with dissemination and promotion;

- project management.

Meetings of Project Boards are called by Coordinator according needs, but Coordinator may call meetings with individual members.

For each task within project **Coordinator appoints Activity Leader, and in coordination with Activity Leader, members of Activity Team.** Coordinator provides Activity Leader human and financial resources and activity timelines expressed through milestones. Although **Activity Leader is autonomous in organization of work on specific activity**, she/he does not have financial autonomy, but **all costs are to be approved by Coordinator.** Activity Leader provides Coordinator with **oral reports** regarding activity progress **each week**, and **each month** provides **short written report** on activity progress and expenditures. At the **end of activity**, Activity Leader provides Coordinator written **Activity Report** on work, results and costs of specific activity.

According to needs, but generally once in month, a **Meeting of Project Team** is organized where state of project progress is presented by Coordinator to all members of project team, and all topics are discussed.

Project Coordinator is responsible for preparation and submission of **reports to European Commission** according to rules defined in Grant Agreement.

2.2 Individual participants

No individual participant is included in this project proposal.

2.3 Consortium as a whole (only if relevant)

Not relevant for the project proposal.

2.4 Resources to be committed

Financial resources

Overall project costs are presented in form A3.

Equipment cost are major project asset. They are estimated as follows:

- the cost of measurement equipment is determined according to information gained in contacts with research centers that are applying calibrated axis for the purpose; it is estimated to be around 250000 EUR.
- the cost of construction of test track is obtained by engagement of consultants from Construction Department of Serbian Railways; their assessment of construction costs is made without taking into account costs of purchasing land for test track, access tracks and railway switches, because this amount depends on selected test track location. Their estimation of costs is presented in the following table:

Integration in European Research Area

After years of political isolation, RVC has difficulties with re-integration in international cooperation. Research connections to European research institutions are lost due to the fact that researchers who cooperated with RVC in the past are mainly retired, and some institutions in East Europe countries changed status (like VUKV in Czech Republic). **More than decade without exchange of know-how** with international institutions had **negative influence on middle-aged researchers** (with 10-20 years of experience). Being that they are still to be main force of RVC during next decade, they **need to establish contacts** to fellow researchers in prominent institutions.

The concept of the project, **development of strategic partnerships** with leading research institutions, will bring RVC to close cooperation to EU, and being that RVC already took part in integration of Balkan research institutions through FP-6 RRTC project, the project is **not only to contribute to inclusion of RVC into ERA, but will also to contribute to future widening of ERA in Balkan region.**

Taking into consideration that development of **sustainable surface transport**, and especially railway transport, are one of research priorities in FP-7, it is to be expected that permanent improvements of railway vehicles safety, modifications due to harmonization requests and adjustments of railway vehicles structures due to needs of intermodal transport will be topics of prime practical interest in future. Railway vehicles dynamics research and research of railway vehicles structures and components fatigue are basis for such investigation. Therefore, **improved RVC**, with strengthening of these research areas should have its place **within FP7 projects.**

Regional aspect

Region of Balkan have **several railway vehicles factories** in almost all countries, producing all kind of railway vehicles. Nevertheless, **RVC**, even in this moment, has **unique experimental research basis**, and after recent change of status of Railway Research Institute "Ilianci" in Bulgaria remain institution providing the most capabilities for experimental investigation of railway vehicles. Strengthening of RVC would **open possibilities to all of those factories** to use RVC services for their own improvements and development.

It is also worthwhile to notice that one of the **major priorities of development of Balkan countries** is building and improvement of **European Corridors** (four of them are passing over Balkan Peninsula). It stresses importance that transport development institutions are going to play in future development of whole region, and **underpins potential impact of strengthening of research institutions** like RVC is.

However strong regional impact may be, **such a project would not be achievable within national or regional borders**, because in this moment RVC, despite its drawbacks, belongs to most advanced regional railway vehicles research institutions, partly because of processes of social transition that had negative influence on research work in whole region, partly due to its close relation to local industry. **Exchange of know-how with prominent EU research institutions** is of **key importance** to all project activities.

It is also important to notice that **RVC in this moment is carrying out research project** "Improvement of suspension systems of railway vehicles" financed by **Ministry of Science of Republic of Serbia**, and takes part in experimental investigations of railway wagons developed in **Wagon Factory Kraljevo** and **wagon factory "Sinvoz" Zrenjanin**. Strengthening of RVC within this project will also **contribute to quality of research in ongoing and future national projects** that RVC will carry out.

At last, the project also has its **political impact**, being that strengthening of RVC, which is located at Kraljevo, also contributes to current policy of **decentralization** of Serbia, proclaimed by Serbian government.

3.2 Spreading excellence, exploiting results, disseminating knowledge

Running behaviour and safety tests are necessary part of new vehicles design, as well as an important tool for fixing problems discovered in exploitation conditions. Therefore, project results will **contribute to development of new types of railway vehicles and improvement of present products** of Serbian large railway vehicles factories at:

- Kraljevo (freight wagons),
- Smederevska Palanka (passenger wagons),

and smaller wagon factories at

- Subotica,
- Zrenjanin.

Results of those types of investigations are **vital research material for RVC's research activities but also for other Serbian research institutions** in field of railway vehicles such as

- Department for Railway Vehicles of Faculty of Mechanical Engineering of University of Belgrade,
- Railway Institute "Kirilo Savic" in Belgrade.

As it has been already pointed out, being that RVC is also partner in FP6 RRTC project, **the results gained in investigations performed by RVC will be available to all RRTC members** and will hence contribute to their research activities. For example, researchers at University of Transport in Sofia (Bulgaria) working on track fatigue problems had already shown interest for such data; similar to that, railway vehicles factory from Burgas has also shown interest for running behaviour and safety tests according UIC-518 procedures.

At last, it is not of least importance that **researchers at RVC** are in the same time **teachers at Department for Railway Machinery** at Faculty of Mechanical Engineering Kraljevo. Improvement of their research knowledge and research experience will certainly have positive **influence to education process and knowledge of future engineers and researchers**.

4. Ethical Issues

The proposed project concerns strengthening of research institution for investigation of railway vehicles, and **does not address any specific ethical, gender or other EU policy issues** other than those that are essence of the call itself.

The project will **promote gender equality** by offering project management positions to female researchers and tendency to employ female researchers during project course.

ETHICAL ISSUES TABLE

	YES	PAGE
Informed Consent		
• Does the proposal involve children?		
• Does the proposal involve patients or persons not able to give consent?		
• Does the proposal involve adult healthy volunteers?		
• Does the proposal involve Human Genetic Material?		
• Does the proposal involve Human biological samples?		
• Does the proposal involve Human data collection?		
Research on Human embryo/foetus		
• Does the proposal involve Human Embryos?		
• Does the proposal involve Human Foetal Tissue / Cells?		
• Does the proposal involve Human Embryonic Stem Cells?		
Privacy		
• Does the proposal involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)		
• Does the proposal involve tracking the location or observation of people?		

Research on Animals		
• Does the proposal involve research on animals?		
• Are those animals transgenic small laboratory animals?		
• Are those animals transgenic farm animals?		
• Are those animals cloning farm animals?		
• Are those animals non-human primates?		
Research Involving Developing Countries		
• Use of local resources (genetic, animal, plant etc)		
• Benefit to local community (capacity building ie access to healthcare, education etc)		
Dual Use		
• Research having potential military / terrorist application		
I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	√	